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Pamphlet No. 936c

INSTRUCTIONS
for the Use and Care of the
Barr & Stroud
Rangefinder

Type F.T. 37.

Base 1 metre or 80 cm.

(Upper Image Inverted)

BARR AND STROUD, LIMITED.

Caxton Street, Anniesland,
Glasgow G13 1HZ
Telephone 041-954 9601 (7 lines)

Kinnaird House, 1 Pall Mall East,
London SW1Y 5AU
Telephone 01-930 1541 (4 lines)

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for the Use and Care of the

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- 2—Appearance of the Range Field (Want of Coincidence).
- 3—Appearance of the Scale viewed through the left Eye-piece.
- 4—Appearance of the Scale viewed through the Scale Window.
- 5—Halving Error (Upper Image too high).
- 6—Halving Error (Upper Image too low).
- 7.—“Infinity” Coincidence. Artificial Adjuster.
- 8.—Elevation and Plan of Rangefinder.

Instrument Data

Base Length	80 cm
Magnification	14 diameters
Type of Field	Coincidence, upper image inverted
Angular Field, Horiz.	3° 0'
" " Vert.	2° 10'
Daylight dia. of Objective	26 mm (1.04 inches)
Exit Pupil	1.8 mm (0.07 inch)
Scale Graduations	From 50 to 5000 yards or metres
Weight of Rangefinder	12½ lbs

APPROXIMATE UNCERTAINTY OF OBSERVATION
UNDER REASONABLE PRACTICAL CONDITIONS

At	50 yards or metres	0.05 yards or metres
100	"	0.15
150	"	0.3
200	"	0.5
250	"	0.8
500	"	3.2
1000	"	13
2000	"	52
3000	"	118
4000	"	208
5000	"	320

and so on, the error varying in proportion to the square of the distance.

The Barr & Stroud Rangefinder

TYPE F.T. 37.

Erecting the Rangefinder.

It is assumed that the mounting for the Rangefinder has been unpacked and erected.

To erect the Rangefinder for use, proceed as follows:—

1. Attach the Rangefinder to the Mounting head. An attachment is provided on the under side of the Rangefinder, at the centre, to suit the type of Mounting supplied.
2. Attach the rubber facepiece to the eyepieces.
3. Uncover the end windows.
4. Uncover the scale window.

Position of the Controlling and Operating Parts of the Rangefinder.

(SEE FIGURE 8 AT END OF PAMPHLET.)

On the faceplate at the centre of the instrument, between the bearing rings, are situated the right eyepiece (for the observation of the range field) and the left eyepiece (for the observation of the range scale). The eyepieces are suitable for use with a gas mask.

The right eyepiece can be focussed to suit the observer by means of a lever.

By the rotation of a small head on the faceplate suitable coloured light filters may be interposed in the field of view when required, as during fog or bright sunshine.

Around the eyepieces there is placed a rubber facepiece, which serves as a soft cushion for the forehead and prevents shock or injury to the eyes of the observer. This facepiece also prevents bright sunlight, cold, rain or dust from affecting the eyes. It should be removed when a gas mask is worn.

At the front or window side, opposite the left eyepiece, there is provided a window through which a second observer may read the indications of the range scale. A hinged cover is provided for the protection of the window when not in use.

On the under side of the tube, to the right of the eyepieces, there is situated the working head, by the operation of which the ranges are determined, and at the side of the working head there is provided a handle for the support of the hand and control of the

Rangefinder. Another handle is situated in a corresponding position at the left side of the instrument, and at the socket of this handle is placed the astigmatiser lever. Both handles are hinged so as to lie along the Rangefinder tube when not in use.

At the ends of the Rangefinder are situated the windows through which the beams of light from the object under observation enter the instrument. These windows are protected by cover caps of pliable material, which should be placed over the windows when the instrument is not in use.

The heads for the adjustment of coincidence and halving are situated on the left enlarged end, at the top rear and on the underside respectively, and are protected by covers which can be rotated in order to expose the heads.

On top of the tube and to the left of the eyepieces of the 1-metre base Rangefinder there is a small optical Finder, with a cross-line in the field of view, to enable the Rangefinder to be quickly directed upon the object.

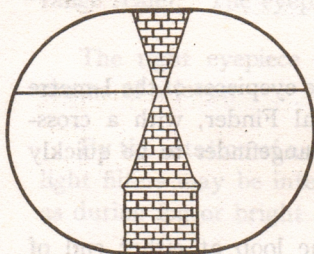
A web carrying sling is provided, the loop at either end of which can, by a slight manipulation, be hooked over two pins in the recesses at either end of the Rangefinder. For the 1-metre base instrument a carrying case is provided.

Appearance of the Right Eye Field of View.

When the observer places his eye sufficiently close to the right eyepiece, the whole boundary of the field of view, which is of oval form, is visible.

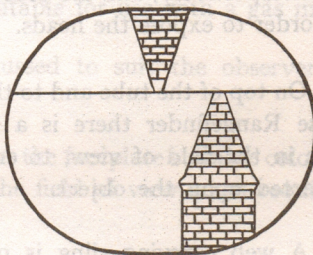
In the horizontal direction the angular width of the field is $3^{\circ}0'$, and in the vertical direction $2^{\circ}10'$; that is to say, all objects embraced within these angles are visible at one time.

Objects in the field appear magnified fourteen times or, in other words, the objects appear as if viewed at a distance of $1/14$ th of their actual range.



515

Fig. 1.



516

Fig. 2.

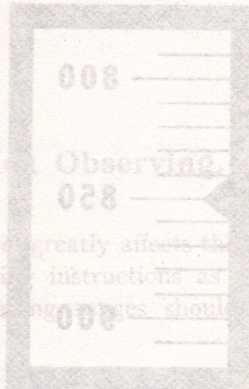
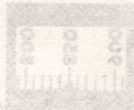
When the eyepiece is focussed there will be seen across the middle of the field a fine, sharply defined horizontal separating line, dividing the field into an upper and a lower portion. The image seen above the separating line is inverted but not reversed right for left.

The upper inverted image is formed by the rays of light which enter the Rangefinder through the left hand window and the lower erect image is formed by rays which enter through the right hand window.

The range field, viewed through the right eyepiece, is illustrated in Fig. 1.

When the images are in coincidence, as in Fig. 1, the scale (Figs. 3 and 4) will indicate the range opposite its index.

When the images are not in coincidence, as in Fig. 2, the scale will not indicate the true range of the object.



Appearance of the Scale.

The appropriate scale divisions are cut and figured on both sides of a dense white perspex strip and, in addition to the left scale eyepiece, provided for the use of the range observer, there is provided, as already described, a scale window through which the indications on the outer side of the perspex may be read directly by a second observer.

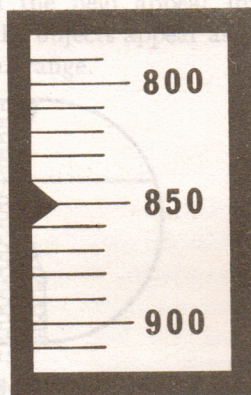


Fig. 3.

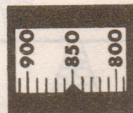


Fig. 4.

When viewed through the window the scale appears in its true horizontal position and the indications are read opposite a black index mark (Fig. 4).

When viewed through the left eyepiece the scale is caused, by a simple arrangement of prisms, to appear to lie vertically (Fig. 3) and thus any interference of the scale image with the image in the right eyepiece is avoided.

At the extreme high range end of the scale there is engraved the "Infinity" line, marked by a star. The small divisions on either side of the "Infinity" graduation are provided for use in testing the coincidence adjustment of the Rangefinder, each division being equivalent to a range error of 10 yards (or metres) at 1000 yards (or metres).

Attitude when Observing.

As the comfort of the observer greatly affects the good working of the Rangefinder, the following instructions as to the proper attitude to be observed in taking ranges should be carefully followed :—

1. The Rangefinder should be supported upon the Mounting at such a level that the observer can rest his face in the rubber facepiece and look with comfort into the eyepieces.

2. Grasp the handles firmly and press the face into the facepiece until the whole field in the right eyepiece can be observed.

3. Place the forefinger and thumb of the right hand on the range working head.

To Determine the Range of an Object.

By moving the range working head the deflecting prism is translated along the path of one of the beams of light. This affects only the right hand beam, and consequently, a motion of the working head displaces the lower picture relatively to the upper in a direction parallel to the separating line. When the two images are brought into very exact alignment the scale indicates the correct range.

To determine the range of an object under ordinary conditions of observation, proceed as follows :—

1. Remove the cover caps from the windows.
2. Direct the Rangefinder upon the object, using the Finder (if supplied) to locate it.
3. Press the face gently into the facepiece and look into the eyepieces.
4. Focus the right eyepiece upon the object by means of the focussing lever.
5. If required, insert a suitable coloured glass in the field of view, by rotating the small head on the faceplate.
6. By suitably directing the Rangefinder, bring the images of the object on to the separating line in the centre of the upper field.

7. Place the forefinger and thumb of the right hand upon the working head and rotate it until the images are in coincidence (Fig. 1).

The accuracy of the range determination depends upon the exactitude of the coincidence setting and in performing this operation great care should be exercised.

8. When the coincidence is exact, read the range through the left eyepiece or, in the case of a second observer, through the scale window.

NOTE.—If the object is small and of indefinite form, or when observing upon a spot of light at night, the images may be drawn out into long vertical streaks by raising the astigmatiser lever with the thumb of the left hand.

It is advisable, when possible, to take as the range the mean of several consecutive readings ; that is, provided the range does not alter appreciably during the operation.

The "Above and Below" Method of Observation.

When the atmospheric conditions are favourable, the range of stationary or slowly moving objects can be obtained most accurately by following what is known as the "above and below" method.

1. Move the working head until the lower image is not in exact alignment but is just perceptibly to the left of the upper.

2. Note the scale indication.

3. Move the working head until the lower image appears out of alignment by an equal amount to the right of the upper.

4. Note the scale indication.

5. Take as the range of the object the arithmetical mean of the two scale indications.

The great accuracy obtainable by the use of the "above and below" method may be explained as follows:—

Suppose that the range of the object is exactly 1,000 yards* and that a change of six yards up and down in the setting of the Rangefinder cannot readily be detected as a want of coincidence. When working with special care the operator may then get indications of range varying from 994 to 1,006 yards.

On the other hand, a change of setting corresponding to eight yards may be distinctly visible. If, then, the observer sets the

* If the scale is in metres, for "yards" read "metres."

scale to read 992, he will see the images perceptibly out of alignment in one direction, and if he sets the scale to read 1,010, they will appear out by about the same amount in the other direction. The arithmetical mean of these readings, namely, 1,001 yards, gives the distance of the object to within one yard of the true range.

If the scale had been set to read 992 and then 1,016, the images at the latter range would have appeared to be twice as far out of coincidence and the difference would have been distinctly visible. Even then, however, the mean would only be 1,004 and, as the observer will readily see the difference between a want of coincidence that is just perceptible and one that is double the amount, great accuracy of observation is obtainable by the use of this method.

The positions of the adjustment heads, by the position of which these two errors can be corrected, have already been mentioned in the section entitled "Position of the Controlling and Operating Parts." The actual adjustments are not difficult to make and need take only a few minutes to perform. The coincidence adjustment must, however, be undertaken very deliberately and carefully, and as far as possible, only when the weather conditions and other circumstances are favourable.

1. Select any well defined object and bring the images into alignment in the field of view. It should be noted that it is not necessary to know the actual range of the object.

2. Direct the Rangefinder in altitude so that the images do not cross the separating line.

Adjustments.

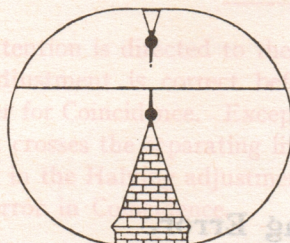
It has been assumed in the preceding instructions that when the two images of an object are brought into alignment in the field of view the upper image appears to form a complete inversion of the lower and that the range then indicated by the scale represents the true range of the object. The Rangefinder may, however, be out of adjustment in one or both of these respects and it should be frequently tested for such errors.

The positions of the adjustment heads, by the operation of which these two errors can be corrected, have already been indicated in the section entitled "Position of the Controlling and Operating Parts." The actual adjustments are not difficult to make and need take only a few minutes to perform. The coincidence adjustment must, however, be undertaken very deliberately and carefully, and, as far as possible, only when the weather conditions and other circumstances are favourable.

* If the scale is in metres, for "yards" read "metres."

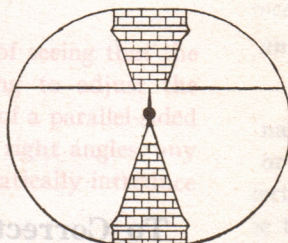
Halving Adjustment.

When the Rangefinder is not correctly adjusted for halving the image in, say, the upper field of view of the instrument may appear either *too high* (as in Fig. 5) or *too low* (as in Fig. 6).



525

Fig. 5.



518.

Fig. 6.

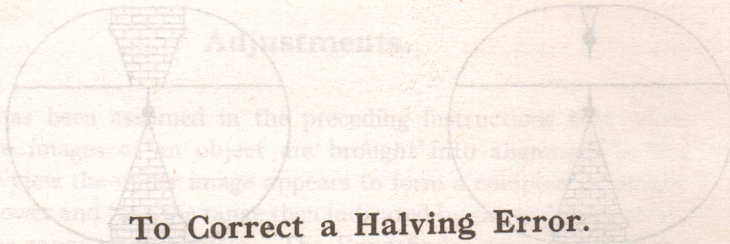
A small amount of halving error will not necessarily affect the coincidence setting of the partial images to any serious extent, except in the case of objects that are inclined to the separating line. It is advisable, however, on all occasions to test halving before commencing to make range observations.

To test the halving adjustment of the instrument, proceed as follows :—

1. Select any well defined object and bring the images into alignment in the field of view. It should be noted that it is not necessary to know the actual range of the object.
2. Direct the Rangefinder in altitude so that the images do not cross the separating line.

3. Gently and steadily rotate the instrument and thus cause the images to approach the separating line.

If halving is correct, the images will meet on the separating line. If they do not, the halving is incorrect and must be corrected.



To Correct a Halving Error.

1. Rotate the small cover to expose the halving head. Move the head in accordance with the instructions engraved at the side
2. Check the adjustment by repeating the halving test.
3. Cover the halving head by rotating the cover.

Coincidence Adjustment.

COINCIDENCE ADJUSTMENT.

SPECIAL attention is directed to the importance of seeing that the Halving adjustment is correct before attempting to adjust the Rangefinder for Coincidence. Except in the case of a parallel-sided object that crosses the separating line exactly at right angles, any slight error in the Halving adjustment will automatically introduce a serious error in Coincidence.

When observing upon the Moon, for example, the curvature of the Moon's periphery makes it imperative that the two portions of the image brought into Coincidence should represent the same part of the object. If a Halving error is present, the portions of the object touching the separating line will not correspond in both fields, and the absence or duplication of part of the curved surface will cause a relative displacement of these portions along the separating line that will produce an error in the scale reading when they are brought into alignment. It is therefore very necessary, as a preliminary to testing the Coincidence adjustment, carefully to test and accurately to adjust Halving.

3. Take a series of at least ten readings and find the mean range.

If the mean of the readings is "Infinity," or within $\frac{2}{5}$ of a division at "Infinity" for the 1-metre base Rangefinder, or half

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Coincidence Adjustment.

Any alteration of the coincidence adjustment should be undertaken very deliberately and carefully and, as far as possible, only when the circumstances are favourable. It is also important that halving should be tested and, if necessary, adjusted with special care before proceeding to adjust coincidence, as a slight error in halving may cause an error in coincidence.

The coincidence adjustment should be tested upon a natural, infinitely distant object such as the moon or a bright star, or upon a suitable object whose range is known to within half the uncertainty of observation (see page 4) for that range. It may also be tested on the Artificial Infinity Adjuster (see page 21).

To examine coincidence by means of the moon or a bright star proceed as follows:—

1. Direct the Rangefinder upon the object.

If the object is the moon, the vertical edge should be worked upon. If the object is a star, the astigmatizer may be used.

2. Examine and, if necessary, adjust halving.

3. Take a series of at least ten readings and find the mean range.

If the mean of the readings is "Infinity," or within $\frac{2}{5}$ of a division at "Infinity" for the 1-metre base Rangefinder, or half

a division for the 80 cm. base Rangefinder, the instrument is in adjustment.

If coincidence is being tested upon an object at known range, the error of the mean reading should be within the approximate uncertainty of observation for that range (see page 4).

To Correct a Coincidence Error.

1. Rotate the range working head until the scale indicates the correct range. (Infinity or known range.)
2. Rotate the small cover to expose the coincidence adjustment head, and move the head in accordance with the instructions engraved at the side until the images are in exact alignment.
3. Take a new series of ten readings and find the mean observation.

When the adjustment is correct to within the allowance, as previously stated, close the cover.

If possible, it will now be advisable to re-check the halving adjustment and then to re-check the coincidence.

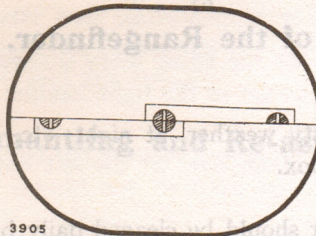


Fig. 7.

"Infinity" Coincidence. Artificial Adjuster.

To Use the Artificial Infinity Adjuster.

1. Set up the Rangefinder box at a distance of not less than 100 yards or metres with the base marks facing the Rangefinder. (The exact distance is immaterial, and need not be measured.)
2. Set the adjuster parallel to the base of the Rangefinder by sighting along the ends of the box.
3. Direct the Rangefinder so as to bring the adjuster marks on to the separating line in the range field.
4. Bring the mark at the *one end* of the adjuster, appearing in the one field, into coincidence with the mark at the *other end*, appearing in the other field, as indicated in Fig. 7.
5. If the scale indicates "infinity," the Rangefinder is in adjustment. If not, proceed as directed in the instructions "To Correct a Coincidence Error" (page 29).

Care of the Rangefinder.

1. In damp or dusty weather, at night, etc., the instrument should be stored in its box.

2. The Rangefinder should be cleaned daily by a careful and responsible man, who should be warned on no account to remove the glasses for cleaning purposes.

3. If from any cause moisture is found to have collected on the inner surfaces of the windows, or on the internal optical parts, the ends should be removed for a short time, as described in items 1, 2 and 3 of the next section, to allow a current of air to pass through the instrument, but this should only be done in dry weather, never in rain or fog, or if dust is about the Rangefinder, *and only when absolutely necessary.*

4. The interior of the Rangefinder box should be kept quite dry and neither the Rangefinder nor any cloths should be put into the box unless they are quite dry.

5. Cloths used for wiping the external surfaces of the glasses should not be used for any other purpose and should be kept thoroughly clean. Care should be taken both in washing and drying them that no sand or grit gets into them, and they should at all times be carefully kept free from dirt.

6. Chamois leathers used for cleaning the external parts of the instrument should not be used to clean the glasses.

Dismantling and Re-assembling.

The Rangefinder should never be opened or dismantled unless there is real necessity for doing so, and on no account should it be dismantled under unfavourable circumstances, when the entrance of grit, dust or moisture is possible.

The following is the sequence of operations necessary for the withdrawal of the inner frame together with all the gear :—

1. Press back the spring at the top and unscrew the right hand end cap.
2. Using the two slots in the bezel ring thus exposed, unscrew the ring and remove with the rubber packing ring.
3. Lift out the end sealing plate.
4. By means of a box key unscrew the two self-locking nuts situated beneath the right pentagonal prism holder and remove the two washers.
5. Withdraw the pentagonal prism holder.
6. Unscrew and remove the two screws at the working head, and remove the head and cap together.
7. Turn the right handle into the horizontal position.

8. Unscrew six screws and remove the faceplate at the centre of the Rangefinder.

9. Unscrew and remove the fixing screw situated on the under side of the tube, at the socket of the right handle.

10. Raise the astigmatism lever at the left handle position.

11. Incline the instrument slightly while keeping the hand over the lower right hand open end. The inner frame will then slide out.

If desired, the left end cap and pentagonal holder may also be removed by performing, at the left end, operations 1, 2, 3, 4 and 5 enumerated above; but the frame can only be withdrawn from the right hand end.

In replacing the inner frame perform the corresponding operations in the reverse order. Care should be taken that the frame is inserted in the correct attitude as regards rotation. Move the astigmatism lenses into the vertical position and raise the astigmatism lever at the left handle position.

Care should be taken that the fixing screw mentioned under operation 9 is properly inserted into its socket in the frame, and in inserting the working head that the clutch is put properly into gear; also in replacing the washers removed in item 4, care should be taken to place the recessed portion against the lug of the pentagonal holder.

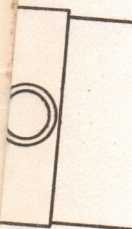
If necessary, the frame may be guided into position through the working head aperture, but on no account should much force

be used for any of the above operations. When replacing the inner frame of the 1 metre base instrument it will be necessary to use a wooden stick about 10 inches (25 cm.) long with a slot at one end with which to grip the frame.

It is advisable that the parts of the frame, and more particularly the optical parts, should not be removed, as they can be satisfactorily cleaned in position.

When replacing the bezel ring at the end of the Rangefinder (see item 2) care should be taken to replace the rubber packing ring.

WINDOW



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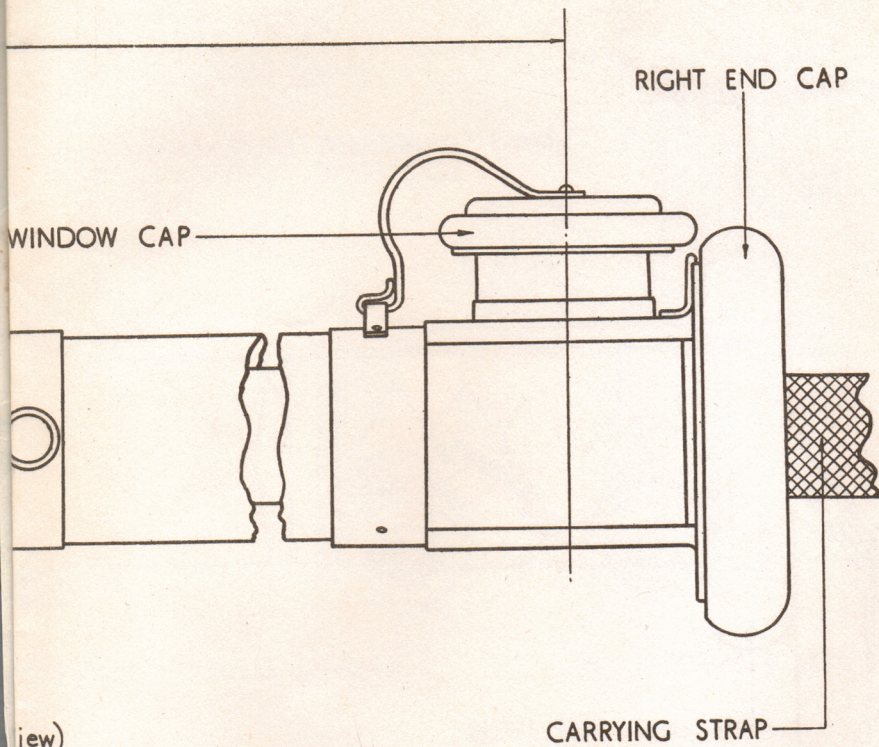


FIG. 8

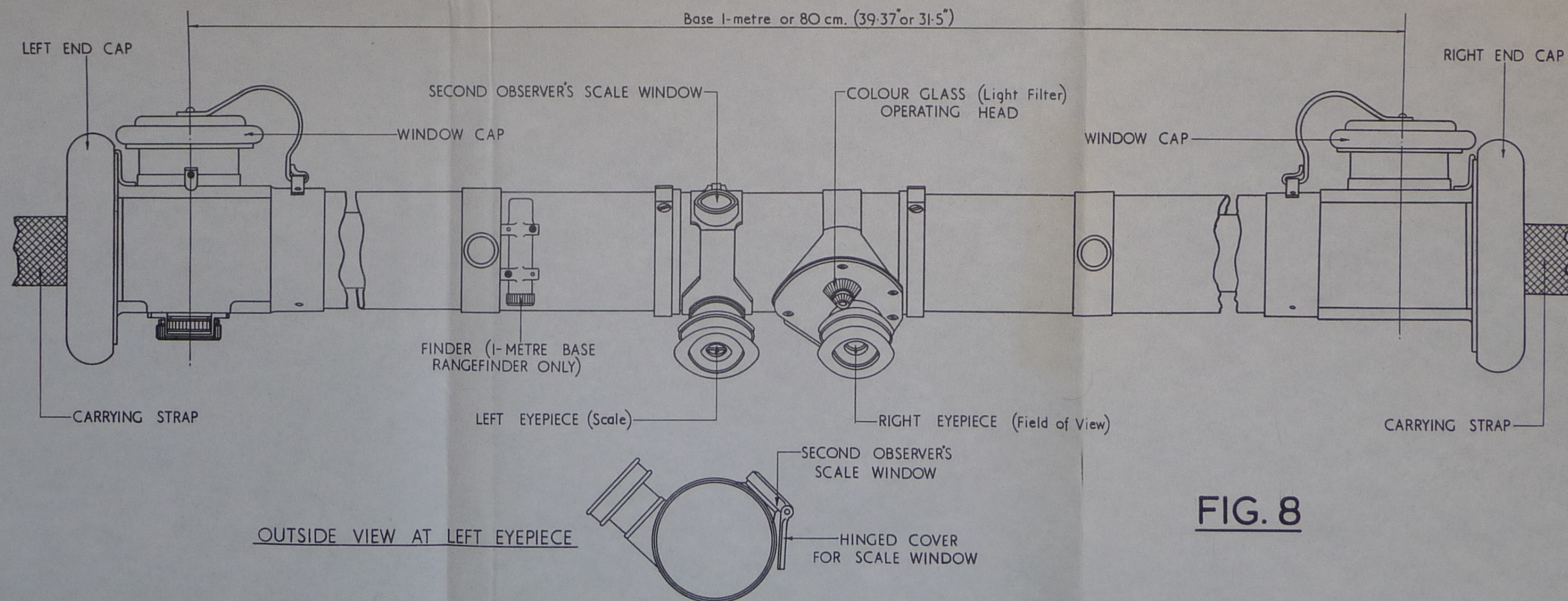
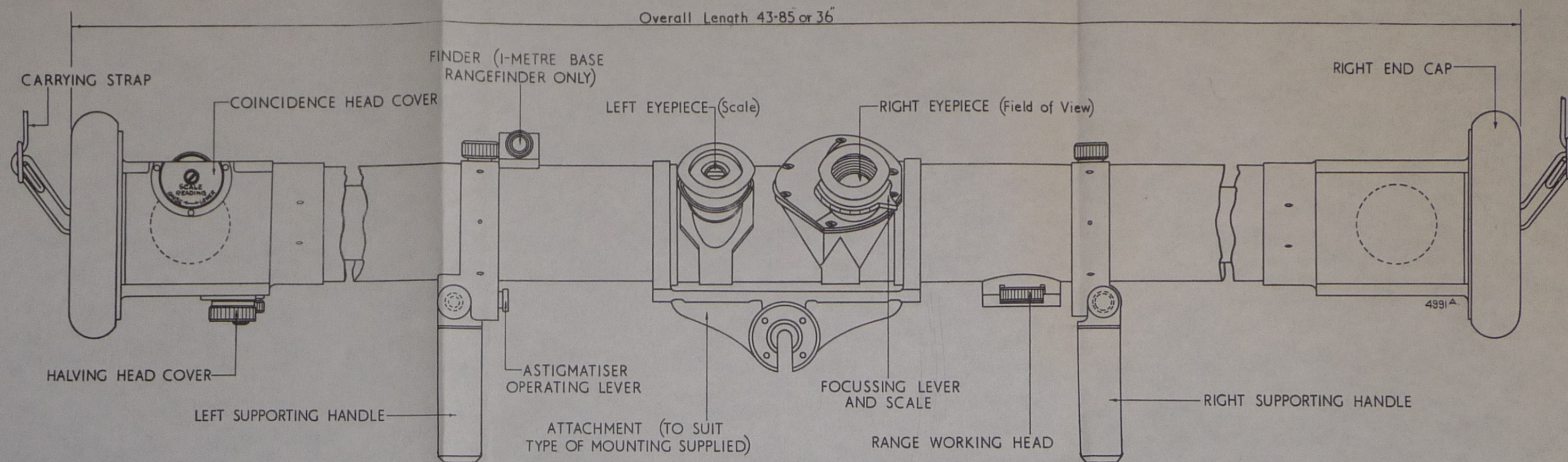
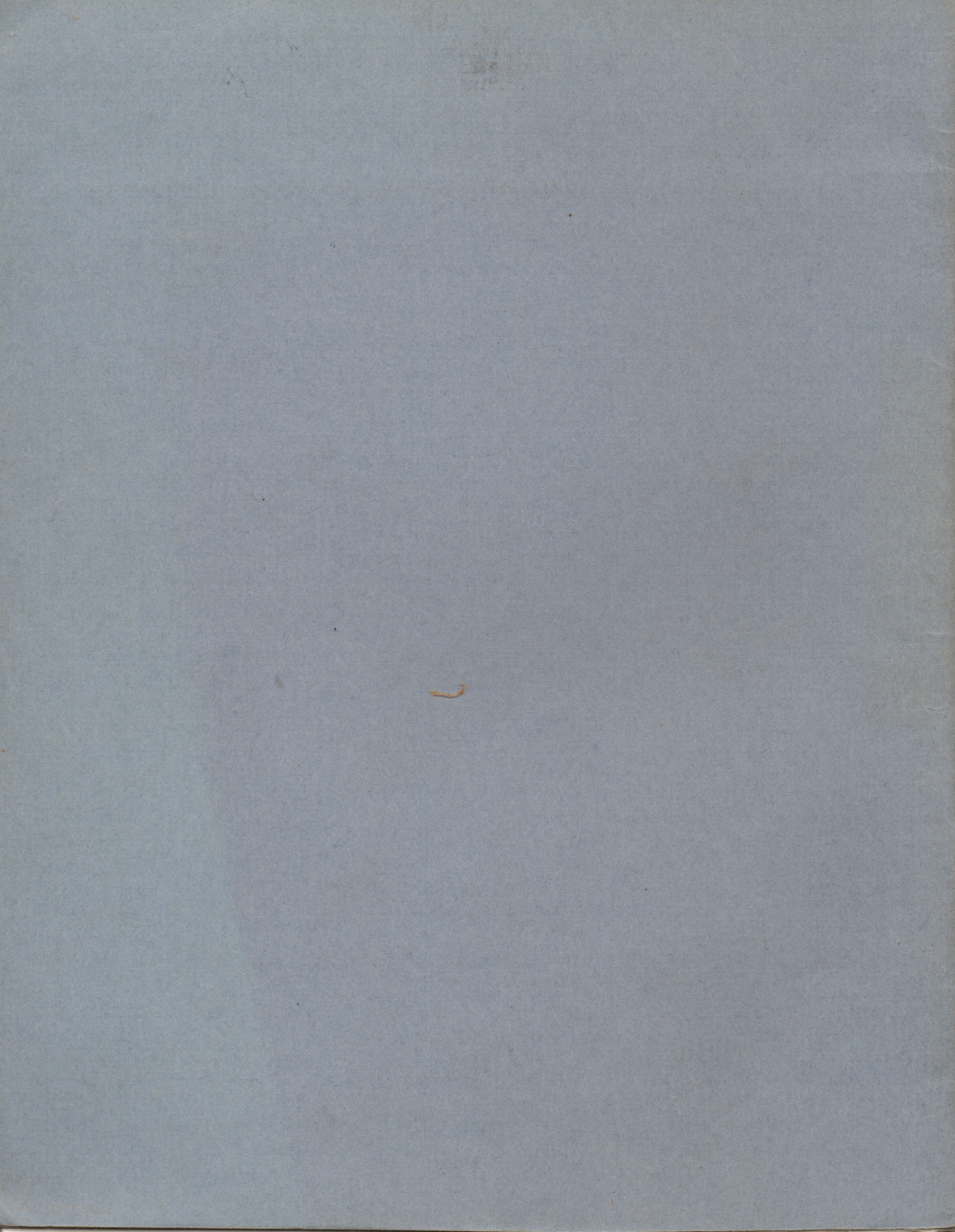


FIG. 8





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